

WHAT IS CLAIMED IS:

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1. A solid-state image pickup device for generating image signals in accordance with incident light, comprising:

5 a semiconductor substrate having one conductive type;  
a semiconductor region formed on one surface of said semiconductor substrate and having a conductive type opposite to said semiconductor substrate;

10 a plurality of channel regions extending in a column direction respectively in said semiconductor region;  
a plurality of picture elements in which electric charges are accumulated defined in each portion of said plurality of channel regions; and

15 a plurality of transfer electrodes, extending in a row direction on said semiconductor region, for transferring the electric charges accumulated in said plurality of channel regions, said plurality of transfer electrodes being allocated to each picture element,

20 said plurality of picture elements including:  
light receiving elements in which the electric charges are accumulated in accordance with the incident lights, and storage elements in which the electric charges transferred from said light receiving elements are stored,

25 said plurality of light receiving elements including:  
a first set of a plurality of light receiving elements in which at least one of the corresponding transfer electrodes is activated and simultaneously at least one of

the transfer electrodes is inactivated in first and second image pickup operations; and

5 a second set of a plurality of light receiving elements in which all of the corresponding transfer electrodes are inactivated in the first image pickup operation, and at least one of the transfer electrodes is activated and simultaneously at least one of the transfer electrodes is inactivated in the second image pickup operation.

10 2. The solid-state image pickup device according to claim 1 wherein said first set of light receiving elements and said second set of light receiving elements are arranged in a matrix form in a predetermined region on the basis of a predetermined arrangement rule.

15 3. The solid-state image pickup device according to claim 2 wherein said first set of light receiving elements and said second set of light receiving elements are aligned in a row direction, and said first set of the plurality of  
20 light receiving elements and said second set of the plurality of light receiving elements are alternately arranged in a column direction.

25 4. The solid-state image pickup device according to claim 1 wherein a channel region under the transfer electrode corresponding to said first light receiving element and a channel region under the transfer electrode corresponding to

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said second light receiving element differ in their concentration of impurities.

5 5. A solid-state image pickup device for generating image signals in accordance with incident light, comprising:

a semiconductor substrate having one conductive type;

a semiconductor region formed on one surface of said semiconductor substrate and having a conductive type opposite to said semiconductor substrate;

10 a plurality of channel regions extending in a column direction respectively in said semiconductor region;

a plurality of picture elements in which electric charges are accumulated defined in each portion of said plurality of channel regions;

15 a plurality of transfer electrodes, extending in a row direction on said semiconductor region, for transferring the electric charges accumulated in said plurality of channel regions and

20 a drive circuit for giving a first electric potential for forming a potential barrier of a predetermined height between the channel regions and the semiconductor substrate region to a first set of a plurality of picture elements and giving a second electric potential for extinguishing the potential barrier between the channel regions and the  
25 semiconductor substrate region to a second set of a plurality of picture elements in a first image pickup operation, and  
for giving the first electric potential for forming the

potential barrier of the predetermined height between the channel regions and the semiconductor substrate region to both of the first set of picture elements and the second set of picture elements in a second image pickup operation,

5 first image signals of continuous frame by frame being obtained by repeatedly performing the first image pickup operation, and second image signals indicative of one frame being obtained by the second image pickup operation.

10 6. The solid-state image pickup device according to claim 5 which further comprises:

a shutter mechanism for controlling light incident on the first and second set of the picture elements,

15 said shutter mechanism permitting the light to be incident on the first set and the second set for only a predetermined period during the second image pickup operation.

20 7. The solid-state image pickup device according to claim 5 wherein the predetermined period for which the light is incident on the first and second set of the picture elements during the second image pickup operation is extended or reduced in accordance with the intensity of the incident light.

25 8. A solid-state image pickup device for generating image signals in accordance with incident lights, comprising:  
a semiconductor substrate having one conductive type;

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a semiconductor region formed on one surface of said semiconductor substrate and having a conductive type opposite to said semiconductor substrate;

5 a plurality of channel regions extending in a column direction respectively in said semiconductor region;

a plurality of picture elements in which information charges are accumulated defined in each portion of said plurality of channel regions;

10 a plurality of transfer electrodes, extending in a row direction on said semiconductor region, for transferring the electric charges accumulated in said plurality of channel regions and

15 a drive circuit for applying, to said semiconductor substrate, a first electric potential for forming a potential barrier of a predetermined height between the channel regions and the semiconductor substrate region in a first period and a second electric potential for restricting the height of the potential barrier between the channel regions and the substrate region in a second period subsequent to the first period,

20 for applying a third electric potential for keeping the potential barrier between the channel regions and the substrate region to a first set of a plurality of picture elements among said plurality of picture elements in the first period and the second period, and

25 for applying, to a second set of a plurality of picture elements among said plurality of picture elements, the third

electric potential during the first period, and a fourth electric potential for extinguishing the potential barrier between the channel regions and the semiconductor substrate region during the second period,

5 the electric charges accumulated in the first set of the picture elements during the first period being transferred in a third period after an elapse of the second period.

10 9. The solid-state image pickup device according to claim 8 wherein said first and second sets of picture elements are both aligned in the row direction, the first set of the picture elements are disposed at intervals in the column direction, and the second set of the picture elements are interposed between the first set of the picture elements.

15 10. The solid-state image pickup device according to claim 9 wherein storage elements in which the electric charges transferred from the picture elements are received and accumulated are disposed adjacent to the first and second  
20 sets of the picture elements, and the number of these storage elements corresponds to that of the first set of the picture elements.

25 11. The solid-state image pickup device according to claim 8 wherein said drive circuit further includes

a second image pickup operation for applying said third electric potential to said transfer electrodes for said first

and second picture elements during said first and second periods,

the first image pickup operation is repeatedly performed over said first period to the third period to obtain a first image signal of continuous frame by frame and

the second image pickup operation is performed to obtain a second image signal indicative of a single static image frame.

12. The solid-state image pickup device according to claim 11 which further comprises:

a shutter mechanism for controlling light incident on the first and second set of the picture elements,

said shutter mechanism permitting the light to be incident on the first set of the picture elements and the second set of the picture elements only for a predetermined period during the second image pickup operation.

13. The solid-state image pickup device according to claim 12 wherein the predetermined period for which the light is incident on the first and second set of the picture elements during the second image pickup operation is extended or reduced in accordance with the intensity of the incident light.

14. The solid-state image pickup device according to claim 8 wherein, at the start of said first period of said

second image pickup operation, said drive circuit applies said second electric potential to said semiconductor substrate, and applies said fourth electric potential to said transfer electrodes to distinguish the potential barrier between said channel regions and said substrate region and to once discharge the information charges in said channel regions.

15. The solid-state image pickup device according to claim 14 wherein said drive circuit sets a start timing of said first period of said second image pickup operation in accordance with the intensity of the light from an object in a period when said picture elements are irradiated with the light.

16. A solid-state image pickup device for generating image signals in accordance with incident light, comprising:

- a semiconductor substrate having one conductive type;
- a semiconductor region formed on one surface of said semiconductor substrate and having a conductive type opposite to said semiconductor substrate;
- a plurality of channel regions extending in a column direction in said semiconductor region;
- a plurality of picture elements in which electric charges are accumulated defined in each portion of said plurality of channel regions;
- a plurality of transfer electrodes, extending in a row



direction on said semiconductor region, for transferring the electric charges accumulated in said picture elements,

wherein said picture elements include:

light receiving elements in which the electric charges  
5 are accumulated in accordance with the incident light and storage elements in which the electric charges transferred from said light receiving elements are accumulated; and wherein:

at least two of the plurality of transfer electrodes are  
10 disposed so as to sandwich a boundary portion between a light receiving region in which said light receiving elements are arranged and a storage region in which said storage elements are arranged,

at least two of the plurality of transfer electrodes are  
15 formed so as to have channel lengths longer than the other channel lengths, and

at least two of the plurality of transfer electrodes  
apply a first transfer clock having a constant cycle to the plurality of transfer electrodes arranged in the light  
20 receiving region and applying a second transfer clock having a cycle longer than the cycle of the transfer clock to the transfer electrodes arranged in the storage region.

17. The solid-state image pickup device according to  
25 claim 16 wherein the number of picture elements arranged in said storage region is set to a value of  $1/n$ , where  $n$  is an integer of 2 or more, of the number of said picture elements

set in said light receiving region, and the cycle of said second transfer clock is  $n$  times longer than the cycle of said first transfer clock.

5 18. A solid-state image pickup device for generating image signals in accordance with incident lights, comprising:

a semiconductor substrate having one conductive type;

10 a semiconductor region formed on one surface of said semiconductor substrate and having a conductive type opposite to said semiconductor substrate;

a plurality of channel regions extending in a column direction respectively in said semiconductor region;

15 a plurality of picture elements in which electric charges are accumulated defined in each portion of said plurality of channel regions;

a plurality of transfer electrodes, extending in a row direction on said semiconductor region, for transferring the electric charges accumulated in said plurality of channel regions; and wherein

20 said picture elements include:

light receiving elements arranged in a light receiving region and in which the electric charges in accordance with the incident lights are accumulated;

25 storage elements arranged in a storage region and in which the electric charges transferred from the light receiving elements in the light receiving region are accumulated; wherein

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said solid-state image pickup device further comprises:  
a drive circuit for applying a first transfer clock  
having a constant cycle to a plurality of transfer electrodes  
arranged in said light receiving region to transfer the  
5 information charges accumulated in said light receiving  
elements every element to said storage region, for applying a  
second transfer clock having a cycle longer than the cycle of  
said first transfer clock to a plurality of transfer  
electrodes arranged in the storage region to selectively  
10 receive, in the storage region, some of the information  
charges transferred from the light receiving region, and for  
subsequently applying a third transfer clock having a cycle  
longer than the cycle of the second transfer clock to  
transfer and output the information charges of the storage  
15 region.

19. The solid-state image pickup device according to  
claim 18 wherein said second transfer clock has clocks of at  
least two types of duty ratios, and the clock with the  
20 smallest duty ratio is allocated to the transfer electrode  
close to said light receiving region among the plurality of  
transfer electrodes.

20. The solid-state image pickup device according to  
25 claim 18 wherein, in a second image pickup operation  
different from said image pickup operation, said drive  
circuit applies said third transfer clock to a plurality of

transfer electrodes arranged in the light receiving region  
and the storage region to transfer and output the information  
charges accumulated in the plurality of light receiving  
elements every element through said storage region.

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